

New Hampshire Volunteer Lake Assessment Program

2002 Bi-Annual Report for Kezar Lake North Sutton



NHDES
Water Division
Watershed Management Bureau
6 Hazen Drive
Concord, NH 03301



OBSERVATIONS & RECOMMENDATIONS

After reviewing data collected from **KEZAR LAKE**, the program coordinators recommend the following actions.

FIGURE INTERPRETATION

- **Figure 1 and Table 1:** The graphs in Figure 1 (Appendix A) show the historical and current year chlorophyll-a concentration in the water column. Table 1 (Appendix B) lists the maximum, minimum, and mean concentration for each sampling season that the lake/pond has been monitored through the program.

Chlorophyll-a, a pigment naturally found in plants, is an indicator of the algal abundance. Because algae are usually microscopic plants that contain chlorophyll-a, and are naturally found in lake ecosystems, the chlorophyll-a concentration found in the water gives an estimation of the concentration of algae or lake productivity. **The mean (average) summer chlorophyll-a concentration for New Hampshire's lakes and ponds is 7.02 ug/L.**

Similar to the summer of 2001, the summer of 2002 was filled with many warm and sunny days and there was a lower than normal amount of rainfall during the latter-half of the summer. The combination of these factors resulted in relatively warm surface waters throughout the state. The lack of fresh water to the lakes/ponds reduced the rate of flushing which may have resulted in water stagnation. Due to these conditions, many lakes and ponds experienced increased algae growth, including filamentous green algae (the billowy clouds of green algae typically seen floating near shore), and some lakes/ponds experienced nuisance cyanobacteria (blue-green algae) blooms.

The current year data (the top graph) show that the mean monthly chlorophyll-a concentration **remained relatively stable** from June to August, and then **decreased slightly** from August to September.

The historical data (the bottom graph) show that the 2002 chlorophyll-a mean is **less than** the state mean. It is worthy to point out that the 2002 chlorophyll-a mean is the lowest annual mean since monitoring began!

Overall, the statistical analysis of the historical data show that the chlorophyll-a concentration has **significantly decreased** since monitoring began. Specifically, the chlorophyll-a concentration has **decreased** (meaning **improved**) on average **by approximately 5.2 percent** per sampling season during the sampling period **1988 to 2002**. (Note: Please refer to Appendix E for the detailed statistical analysis explanation and data print out.) We hope this trend continues!

While algae are naturally present in all lakes/ponds, an excessive or increasing amount of any type is not welcomed. In freshwater lakes/ponds, phosphorus is the nutrient that algae depend upon for growth. Therefore, algal concentrations may increase when there is an increase in nonpoint sources of nutrient loading from the watershed, or in-lake sources of phosphorus loading (such as phosphorus releases from the sediments). Although the chlorophyll-a concentration in the lake has decreased since monitoring began, it is important to continually educate residents about how activities within the watershed can affect phosphorus loading and lake quality.

- **Figure 2 and Table 3:** The graphs in Figure 2 (Appendix A) show historical and current year data for lake/pond transparency. Table 3 lists the maximum, minimum and mean transparency data for each sampling season that the lake/pond has been monitored through the program.

Volunteer monitors use the Secchi-disk, a 20 cm disk with alternating black and white quadrants, to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, can be affected by the amount of algae and sediment from erosion, as well as the natural colors of the water. **The mean (average) summer transparency for New Hampshire's lakes and ponds is 3.7 meters.**

Two different weather related patterns occurred this past spring and summer that influenced lake quality during the summer season.

In late May and early June of 2002, numerous rainstorms occurred. Stormwater runoff associated with these rainstorms may have increased phosphorus loading, and the amount of soil particles washed into waterbodies throughout the state. Some lakes and ponds experienced lower than typical transparency readings during late May and early June.

However, similar to the 2001 sampling season, the lower than average amount of rainfall and the warmer temperatures during the latter-half of the summer resulted in a few lakes/ponds reporting their best-ever

Secchi-disk readings in July and August (a time when we often observe reduced clarity due to increased algal growth)!

The current year data (the top graph) show that the mean monthly in-lake transparency **remained relatively stable** from June to August, and then **decreased slightly** from August to September.

The historical data (the bottom graph) show that the 2002 mean transparency is **slightly less than** state mean.

Overall, the statistical analysis of the historical data (the bottom graph) show that the mean annual in-lake transparency has **not significantly changed** (either *continually increased* or *decreased*) since monitoring began in **1988**. Specifically, the in-lake transparency has remained **relatively stable**, ranging between approximately **2** and **3** meters. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.) The slightly tea color of the lake water is a probably why the transparency has not significantly increased.

Typically, high intensity rainfall causes erosion of sediments into lakes/ponds and streams, thus decreasing clarity. Efforts should continually be made to stabilize stream banks, lake/pond shorelines, disturbed soils within the watershed, and especially dirt roads located immediately adjacent to the edge of tributaries and the lake/pond. Guides to Best Management Practices designed to reduce, and possibly even eliminate, nonpoint source pollutants, such as sediment loading, are available from NHDES upon request.

- **Figure 3 and Table 8:** The graphs in Figure 3 (Appendix A) show the amounts of phosphorus in the epilimnion (the upper layer) and the hypolimnion (the lower layer); the inset graphs show current year data. Table 8 (Appendix B) lists the annual maximum, minimum, and median concentration for each deep spot layer and each tributary since the lake/pond has joined the program.

Phosphorus is the limiting nutrient for plant and algae growth in New Hampshire's freshwater lakes and ponds. Too much phosphorus in a lake/pond can lead to increases in plant and algal growth over time. **The median summer total phosphorus concentration in the epilimnion (upper layer) of New Hampshire's lakes and ponds is 11 ug/L. The median summer phosphorus concentration in the hypolimnion (lower layer) is 14 ug/L.**

The current year data for the epilimnion (the top inset graph) show that the mean monthly total phosphorus concentration **increased** from June to July, and then **decreased** from July to September. The mean monthly total phosphorus concentration was **greater than** the

state median in July and August. It is important to note that the epilimnetic total phosphorus concentration on the June 16th sampling event was high (47 ug/L). This may have been a result of rain events which may have washed phosphorus into the lake prior to sampling.

The historical data show that the 2002 mean epilimnetic total phosphorus concentration is **approximately equal to** the state median.

The current year data for the hypolimnion (the bottom inset graph) show that the mean monthly total phosphorus concentration **increased** from June to July, and then **decreased gradually** from July to September. The mean monthly total phosphorus concentration was **greater than** the state median in July and August.

The historical data show that the 2002 mean hypolimnetic total phosphorus concentration is **approximately equal to** the state median.

Overall, the statistical analysis of the historical data show that the phosphorus concentration in the epilimnion (upper layer) and the hypolimnion (lower layer) has **significantly decreased** since monitoring began. Specifically, the phosphorus concentration has **improved** on average by approximately **3.8 percent per sampling season** in the epilimnion and **3.4 percent per sampling season** in the hypolimnion during the sampling period **1988 to 2002**. (Note: Please refer to Appendix E for the statistical analysis explanation and data print out.) We hope this trend continues!

One of the most important approaches to reducing phosphorus loading to a waterbody is to continually educate watershed residents about its sources and how excessive amounts can adversely impact the ecology and value of lakes and ponds. Phosphorus sources within a lake or pond's watershed typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands. If you would like to educate watershed residents about how they can help to reduce phosphorus loading into the lake/pond, please contact the VLAP Coordinator.

TABLE INTERPRETATION

➤ Table 2: Phytoplankton

Table 2 lists the current and historic phytoplankton species observed in the lake/pond. The dominant phytoplankton species observed this year was **Chrysosphaerella (a golden-brown algae)** in June and July, **Dinobryon (a golden-brown algae)** in August, and **Melosira (a diatom)** in September.

Phytoplankton populations undergo a natural succession during the growing season (Please refer to page 12 of the “Biological Monitoring Parameters” section of this report for a more detailed explanation regarding seasonal plankton succession). Diatoms and golden-brown algae are typical in New Hampshire’s less productive lakes and ponds. An overabundance of cyanobacteria (previously referred to as blue-green algae) indicates that there may be an excessive total phosphorus concentration in the lake/pond, or that the ecology is out of balance.

➤ **Table 2: Cyanobacteria (Blue-green algae)**

Small amounts of the cyanobacterium *Anabaena* was observed in the **June** plankton sample. In addition, small amounts of the cyanobacterium *Oscillatoria* was observed in the **August** and **September** plankton samples. ***These species, if present in large amounts, can be toxic to livestock, wildlife, pets, and humans.*** Cyanobacteria can reach nuisance levels when excessive nutrients and favorable environmental conditions occur.

As with the summer of 2001, we observed that some lakes and ponds had cyanobacteria present during the 2002 summer season, likely due to the many warm and sunny days that occurred this summer, which may have accelerated algal and bacterial growth. In addition, the lower than normal amount of rainfall during the latter half of the summer, meant that the slow flushing rates resulted in less phosphorus exiting the lake outlet and more phosphorus being available for plankton growth.

The presence of cyanobacteria serves as a reminder of the lake’s/pond’s delicate balance. Watershed residents should continue to act proactively to reduce nutrient loading into the lake/pond by eliminating fertilizer use on lawns, keeping the lake/pond shoreline natural, re-vegetating cleared areas within the watershed, and properly maintaining septic systems and roads.

In addition, residents should also observe the lake/pond in September and October during the time of fall turnover (lake mixing) to document any algal blooms that may occur. Cyanobacteria (blue-green algae) have the ability to regulate their depth in the water column by producing or releasing gas from vesicles. However, occasionally lake mixing can affect their buoyancy and cause them to rise to the surface and bloom. Wind and currents tend to “pile” cyanobacteria into scums that accumulate in one section of the lake/pond. If a fall bloom occurs, please contact the VLAP Coordinator.

➤ **Table 4: pH**

Table 4 (Appendix B) presents the in-lake and tributary current year and historical pH data.

pH is measured on a logarithmic scale of 0 (acidic) to 14 (basic). pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish. A pH between 6.5 and 7.0 is ideal for fish. The mean pH value for the epilimnion (upper layer) in New Hampshire's lakes and ponds is 6.5, which indicates that the surface waters in state are slightly acidic. For a more detailed explanation regarding pH, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The mean pH at the deep spot this season ranged from **6.23** in the hypolimnion to **6.63** in the epilimnion, which means that the water is **endangered (toxic to some aquatic organisms)**.

Due to the presence of granite bedrock in the state and the deposition of acid rain, there is not much that can be done to effectively increase lake/pond pH.

➤ **Table 5: Acid Neutralizing Capacity**

Table 5 in Appendix B presents the current year and historic epilimnetic ANC for each year the lake/pond has been monitored through VLAP.

Buffering capacity or ANC describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. For a more detailed explanation, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The Acid Neutralizing Capacity (ANC) of the epilimnion (the upper layer) continues to remain **low** (4.74 mg/L as CaCO₃) and is **less than** the state mean of 6.7 mg/L (Table 5). Specifically, this means that the lake/pond is **"moderately vulnerable"** to acidic inputs (such as acid precipitation).

➤ **Table 6: Conductivity**

Table 6 in Appendix B presents the current and historic conductivity values for tributaries and in-lake data. Conductivity is the numerical expression of the ability of water to carry an electric current. For a more detailed explanation, please refer to page 16 of the "Chemical Monitoring Parameters" section of this report.

The conductivity has **increased** in the lake/pond and inlets since monitoring began (Table 6). Typically, sources of increased

conductivity are due to human activity. These activities include septic systems that fail and leak leachate into the groundwater (and eventually into the tributaries and the lake/pond), agricultural runoff, and road runoff (which contains road salt during the spring snow melt). New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which could contribute to increasing conductivity. In addition, natural sources, such as iron deposits in bedrock, can influence conductivity. It is possible that the lower than normal amount rainfall during the latter-half of the summer reduced tributary and lake flushing, which allowed pollutants and ions to build up and resulted in elevated conductivity levels.

We recommend that the Kezar Lake Watershed Committee conduct stream surveys and stormwater sampling along the inlets with elevated conductivity (in particular the **Lyon Brook at Trussel Ridge** station) so that we can determine what may be causing the increases. For a detailed explanation on how to conduct a stream survey and stormwater sampling, please refer to this year's "Special Topic Article" which is included in Appendix D of this report.

➤ **Table 8: Total Phosphorus**

Table 8 in Appendix B presents the current year and historic total phosphorus data for in-lake and tributary stations. Phosphorus is the nutrient that limits the algae's ability to grow and reproduce. Please refer to page 17 of the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The total phosphorus concentration in the **Inlet** was elevated (46 ug/L) on the **August 28th** sampling event. The turbidity of the sample was also elevated (3.34 NTUs), which suggests that the stream bottom may have been disturbed while sampling (Table 11). When the stream bottom is disturbed, sediment, which typically contains attached phosphorus, is released into the water column. When collecting samples in the inlets, please be sure to sample where there the stream is flowing and where the stream is deep enough to collect a "clean" sample.

➤ **Table 9 and Table 10: Dissolved Oxygen and Temperature Data**

Table 9 in Appendix B shows the dissolved oxygen/temperature profile(s) for the 2002 sampling season. Table 10 shows the historical and current year dissolved oxygen concentration in the hypolimnion (lower layer). The presence of dissolved oxygen is vital to fish and amphibians in the water column and also to bottom-dwelling organisms. Please refer to the "Chemical Monitoring Parameters" section of this report for a more detailed explanation.

The dissolved oxygen concentration was **low in the bottom meter of the hypolimnion** at the deep spot of the lake/pond on the July, August, and September sampling events. As stratified lakes/ponds age, oxygen becomes **depleted** in the hypolimnion (the lower layer) by the process of decomposition. In addition, depleted oxygen concentration in the hypolimnion of thermally stratified lakes/ponds typically occurs as the summer progresses. Specifically, the loss of oxygen in the hypolimnion results primarily from the process of biological breakdown of organic matter (i.e.; biological organisms use oxygen to break down organic matter), both in the water column and particularly at the bottom of the lake/pond where the water meets the sediment. When oxygen levels are depleted to less than 1 mg/L in the hypolimnion (**as it was this season and in many past seasons**), the phosphorus that is normally bound up in the sediment may be re-released into the water column.

➤ **Table 11: Turbidity**

Table 11 in Appendix B lists the current year and historic data for in-lake and tributary turbidity. Turbidity in the water is caused by suspended matter, such as clay, silt, and algae. Water clarity is strongly influenced by turbidity. Please refer to page 19 of the “Other Monitoring Parameters” section of this report for a more detailed explanation.

DATA QUALITY ASSURANCE AND CONTROL

Annual Assessment Audit:

During the annual visit to your lake/pond, the biologist conducted a “Sampling Procedures Assessment Audit” for your monitoring group. Specifically, the biologist observed the performance of your monitoring group while sampling and filled out an assessment audit sheet to document the ability of the volunteer monitors to follow the proper field sampling procedures (as outlined in the VLAP Monitor’s Field Manual). This assessment is used to identify any aspects of sample collection in which volunteer monitors are not following the proper procedures, and also provides an opportunity for the biologist to retrain the volunteer monitors as necessary. This will ultimately ensure that the samples that the volunteer monitors collect are truly representative of actual lake and tributary conditions.

Overall, your monitoring group did an **excellent** job collecting samples on the annual biologist visit this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the biologist to provide additional training. Keep up the good work!

Sample Receipt Checklist:

Each time your monitoring group dropped off samples at the laboratory this summer, the laboratory staff completed a sample receipt checklist to assess and document if the volunteer monitors followed proper sampling techniques when collecting the samples. The purpose of the sample receipt checklist is to minimize, and hopefully eliminate, future re-occurrences of improper sampling techniques.

Overall, the sample receipt checklist showed that your monitoring group did an **excellent** job when collecting samples and submitting them to the laboratory this season! Specifically, the members of your monitoring group followed the proper field sampling procedures and there was no need for the laboratory staff to contact your group with questions, and no samples were rejected for analysis. However, the laboratory did identify one aspect of sample collection that the volunteer monitors could improve upon.

- **Sample “Cooling”:** Please remember to bring a cooler with ice when you sample. Samples should be put directly into the cooler and kept on ice until they are dropped off at the laboratory. This will ensure that samples do not degrade before they are analyzed.

OTHER COMMENTS

- Lake testing in 2002 showed that the quality of Kezar Lake met the standards required by the Court Consent Decree. Specifically, ten weekly sampling rounds were conducted between the last week in June and Labor Day (a total of 13 sampling rounds were conducted for the entire summer season). Furthermore, during the sampling season, there were not four chlorophyll-a values greater than or equal to 10 ug/L, and there were not four transparency values less than 2 meters. Specifically, there were no chlorophyll-a concentration greater than 10 ug/L, and there were no transparency values less than 2 meters. As a requirement of the consent decree, sampling will be conducted each summer until December 31st, 2004.

NOTES

- **Monitor’s Note (6/25/02):** Lots of pollen on the surface and in the water column.
- **Biologist’s Note (8/5/02):** Lyon Brook had no flow so no sample taken.

- **Laboratory Note (8/5/02):** The turbidity of the lower layer sample was elevated. The sample was put under the microscope and ***Oscillatoria*** (a cyanobacteria) was found to be the dominant phytoplankton species in the sample.
- **Monitor's Note (8/12/02):** Lyon Brook at Trussel was too dry to sample properly so no sample taken.
- **Monitor's Note (8/19/02):** Rainstorm (0.7") yesterday. No flow at Lyon Brook at Trussel Ridge so no sample taken. Took sample below dam at outlet because water level was down at dam.
- **Monitor's Note (8/26/02):** Only a puddle of water at Lyon Brook at Trussel Ridge so no sample taken.

USEFUL RESOURCES

Changes to the Comprehensive Shoreland Protection Act: 2001 Legislative Session, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/sp/sp-8.htm

Cyanobacteria in New Hampshire Waters Potential Dangers of Blue-Green Algae Blooms, NHDES Fact Sheet, (603) 271-3505, or www.des.state.nh.us/factsheets/wmb/wmb-10.htm

Organizing Lake Users: A Practical Guide. Written by Gretchen Flock, Judith Taggart, and Harvey Olem. Copies are available from the Terrene Institute (internet: www.terrene.org, phone 800-726-4853)

Proper Lawn Care in the Protected Shoreland: The Comprehensive Shoreland Protection Act, WD-SP-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/sp/sp-2.htm

Sand Dumping - Beach Construction, WD-BB-15, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-15.htm

Swimmers Itch, WD-BB-2, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-2.htm

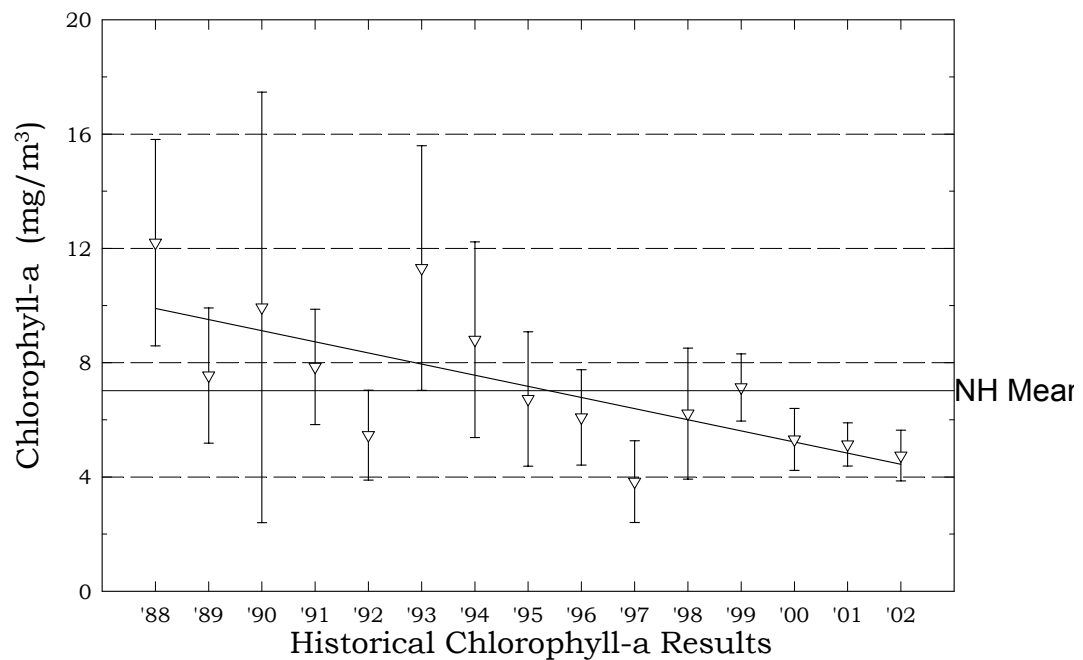
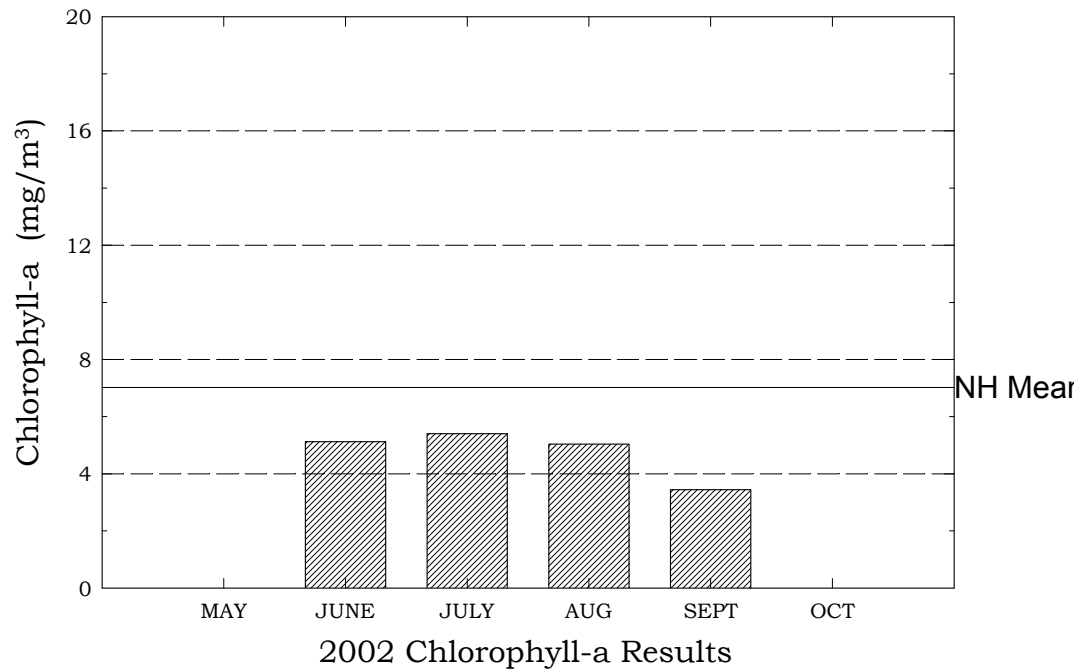
Use of Lakes or Streams for Domestic Water Supply, WD-WSEB-1-11, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/ws/ws-1-11.htm

Weed Watchers: An Association to Halt the Spread of Exotic Aquatic Plants, WD-BB-4, NHDES Fact Sheet, (603) 271-3503 or www.des.state.nh.us/factsheets/bb/bb-4.htm

Appendix A: Graphs

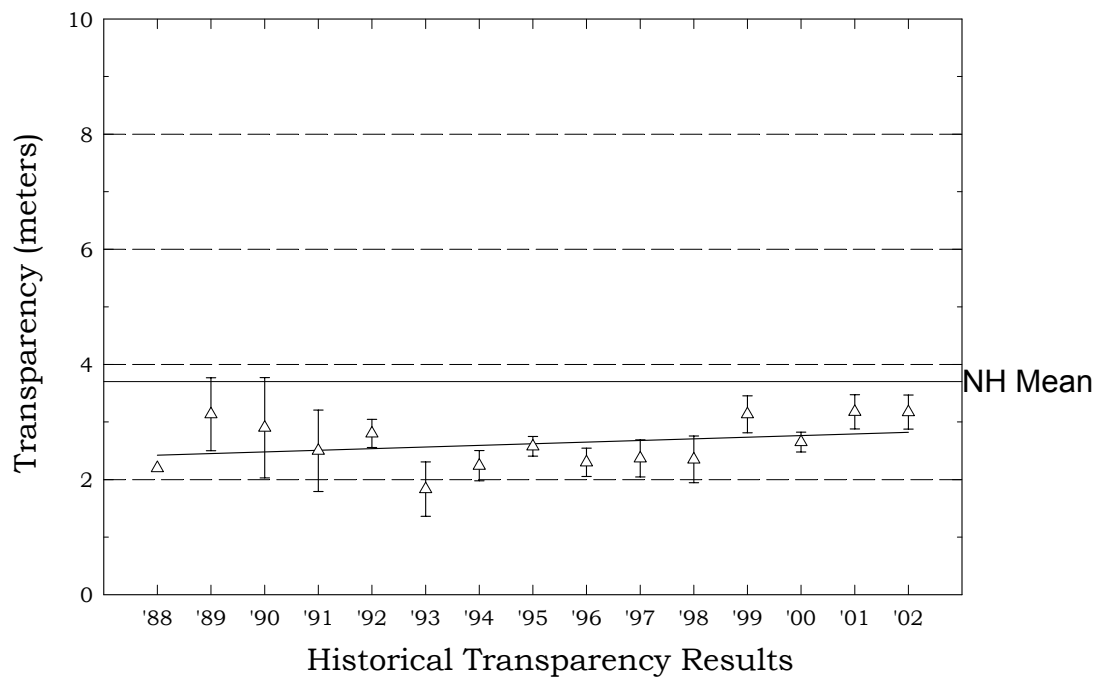
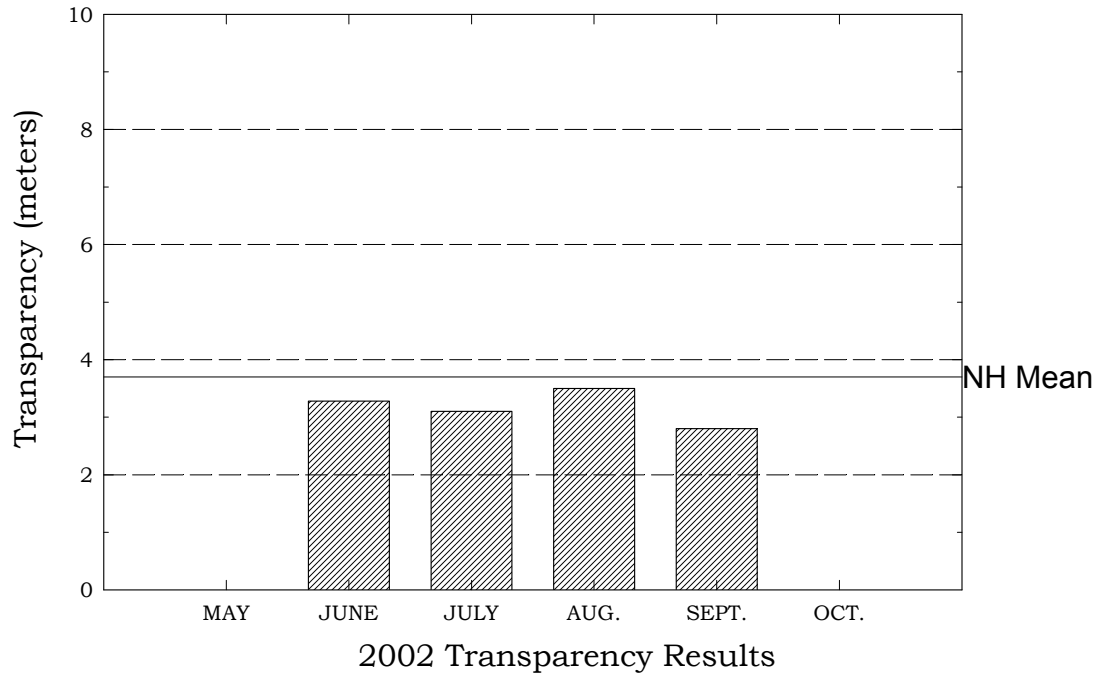
Kezar Lake, North Sutton

Figure 1. Monthly and Historical Chlorophyll-a Results



Kezar Lake, North Sutton

Figure 2. Monthly and Historical Transparency Results



Kezar Lake, North Sutton

Figure 3. Monthly and Historical Total Phosphorus Data.

